[0073] While the invention has been described with reference to preferred embodiments, it will be understood by those skilled in the art that various changes may be made and equivalents may be substituted for elements thereof without departing from the scope of the invention. In addition, many modifications may be made to adapt a particular situation or material to the teachings of the invention without departing from the essential scope thereof. Therefore, it is intended that the invention not be limited to the particular embodiments disclosed herein, but that the invention will include all embodiments falling within the scope of the appended claims.

Claims

[c1] 1. An icemaker assembly disposed within a freezer assembly, said icemaker assembly comprising a conveyor assembly positioned within a freezer compartment of said freezer assembly, having at least a front roller and a rear roller and a continuous flexible conveyor belt fitted in tension about said front and rear rollers, said conveyor belt having a multiplicity of individual ice cube molds for creation of individual cubes therein; and at least one ice cube storage bin positioned below said conveyor assembly for storage of said ice cubes.

[c2] 2. An icemaker assembly in accordance with claim 1 wherein said freezer assembly is a refrigerator having a freezer compartment and a fresh food compartment.

[c3] 3. An icemaker assembly in accordance with claim 1 wherein said refrigerator is a side-by-side refrigerator.

[c4] 4. An icemaker assembly in accordance with claim 1,wherein said continuous flexible conveyor belt is made from the group consisting of thermoplastic elastomer, butyl rubber, chlorobutyl rubber, natural rubber, synthetic rubber, neoprene rubber, polyurethane, ethylene-propylene-diene modified, ethylene-propylene rubber, and silicone rubber.

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Claims

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[c2] 2. An icemaker assembly in accordance with claim 1 wherein said freezer assembly is a refrigerator having a freezer compartment and a fresh food compartment.

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[c5] 5. An icemaker assembly in accordance with claim 1, wherein said continuous flexible conveyor belt has a length in the range between about 12 in. to about 18 in.

[c6] 6. An icemaker assembly in accordance with claim 1, wherein said continuous flexible conveyor belt has a width in the range between about 3 in. to about 8 in.

[c7] 7. An icemaker assembly in accordance with claim 1, wherein said continuous flexible conveyor belt has between about 20 individual ice cube molds to about 300 individual ice cube molds.

[c8] 8. An icemaker assembly in accordance with claim 1, wherein said continuous flexible conveyor belt has between about 10 individual rows of ice cube molds and about 30 individual rows of ice cube molds.

[c9] 9. An icemaker assembly in accordance with claim 1, wherein said ice cube molds are made of a rigid material and are attached to said flexible conveyor belt.

[c10] 10. An icemaker assembly in accordance with claim 1, wherein said rigid material is selected from the group consisting of polypropylene, polyethylene, nylon, and ABS.

[c11] 11. An icemaker assembly in accordance with claim 1 wherein said continuous flexible conveyor belt has between about 2 individual columns of ice cube molds and about 10 individual columns of ice cube molds.

[c12] 12. An icemaker assembly in accordance with claim 1 further comprising a first motor drivingly coupled to at least one of said front or rear rollers, wherein said first motor is selectively energizable to drive said rollers and rotate said belt.

[c13] 13. An icemaker assembly in accordance with claim 1 wherein the fullness of said ice cubes in said ice cube storage bin is detected by a fullness sensor.

[c14] 14. An icemaker assembly in accordance with claim 13 wherein said fullness sensor is a weight determining means.

[c15] 15. An icemaker assembly in accordance with claim 14 wherein said weight determining means is a microswitch.

[c16] 16. An icemaker assembly in accordance with claim 13 wherein said fullness sensor is an ultrasonic level detector.

[c17] 17. An icemaker assembly in accordance with claim 1 wherein each ice cube mold within a single row of flexible conveyor belt is connected to each adjacent ice cube molds with a deep-narrow weir.

[c18] 18. An icemaker assembly in accordance with claim 1 wherein said flexible conveyor belt includes fanfold wells having alternating blades such that a path of continuous material follows a serpentine path in the direction that said ice cube molds are to be stretched.

[c19] 19. An icemaker assembly in accordance with claim 1 further comprising a harvester bar disposed adjacent said front roller for harvesting ice cubes from said ice cube molds as said molds advance over said front roller.

[c20] 20. An icemaker assembly in accordance with claim 1 further comprising a refill valve disposed within said freezer compartment and positioned above at least one of said ice cube molds.

[c21] 21. An icemaker assembly in accordance with claim 1 further comprising a second motor positioned within said freezer door that is drivingly coupled to an ice crusher, which ice crusher either selectively crushes ice cubes or delivers whole ice cubes.

[c22] ~~22.~~ An icemaker assembly in accordance with claim 1 wherein said second motor is energized via an actuation device.

[c23] 23. An icemaker assembly in accordance with claim 1 wherein said at least one ice cube storage bin is positioned within a freezer door of said freezer compartment.

[c24] 24. An icemaker assembly in accordance with claim 23 wherein said storage bin is a molded plastic bin permanently disposed within said freezer door.

[c25] 25. An icemaker assembly in accordance with claim 23 wherein said storage bin is a party ice container removably disposed within said freezer door.

[c26] 26. An ice cube conveyor assembly in accordance with claim 1 wherein said ice cube conveyor assembly is positioned in a top portion of said freezer compartment.

[c27] 27. An ice cube conveyor assembly in accordance with claim 26 wherein said ice cube conveyor assembly is disposed within a conveyor housing.

[c28] 28. An icemaker assembly disposed within a freezer compartment, having a freezer door assembly, said icemaker assembly comprising: a conveyor assembly positioned within said freezer compartment having at least a front roller and a rear roller and a continuous flexible conveyor belt fitted in tension about said front and rear rollers, said belt having a multiplicity of individual ice cube molds for creation of individual ice cubes therein; a first ice cube storage bin disposed within an upper portion of said freezer door assembly adjacent said front roller of said conveyor

assembly, wherein said first ice cube storage bin is alignable with said conveyor assembly to receive ice cubes therefrom; a first motor drivingly coupled to said conveyor assembly for advancing said conveyor belt; a controller electronically coupled to said first motor; and a second ice cube storage bin removably disposed within a lower portion of said freezer door assembly, wherein said second ice cube storage bin variably communicates with said first ice cube storage bin to receive ice cubes therefrom.

[c29] 29. An icemaker assembly according to claim 28 further comprising a refill valve electronically coupled to said controller to fill respective molds with water.

[c30] 30. An icemaker assembly according to claim 28 further comprising a second motor, positioned within a freezer door, which second motor is drivingly coupled to an ice crusher, which ice crusher selectively crushes ice cubes or delivers whole ice cubes.

[c31] 31. An icemaker assembly according to claim 28 wherein said controller generates a signal to energize said first motor when a fullness sensor is activated in relation to said first ice cube storage bin.

[c32] 32. An icemaker assembly according to claim 28 wherein said flexible conveyer belt is made of a flexible polymer.

[c33] 33. An icemaker assembly according to claim 32 wherein said flexible polymer is selected from the group consisting of thermoplastic elastomer, butyl rubber, chlorobutyl rubber, natural rubber, synthetic rubber, neoprene rubber, polyurethane, ethylene-propylene-diene modified, ethylene-propylene rubber, and silicone rubber.

[c34] 34. An icemaker assembly according to claim 28 wherein said ice cube molds are molded directly into the material of said flexible conveyor belt.

[c35] 35. An icemaker assembly according to claim 48 wherein said ice cube molds are made of a rigid material and are fixedly attached to said conveyor belt.

[c36] 36. An icemaker assembly according to claim 35 wherein said rigid material can is selected from the group consisting of polypropylene, polyethylene, nylon, and ABS.

[c37] 37. An icemaker assembly according to claim 28 wherein a nominal linear length (l) of said flexible conveyor belt is in the range between about 12 inches to about 18 inches.

[c38] 38. An icemaker assembly according to claim 28 wherein a nominal width (w) of said flexible conveyor belt is in the range between about 3 inches to about 8 inches.

[c39] 39. An icemaker assembly according to claim 28 wherein a nominal depth (d) of said flexible conveyor belt is in the range between about 0.5 inches to about 1.5 inches.

[c40] 40. An icemaker assembly according to claim 28 wherein a nominal number of said individual ice cube molds is in the range between about ~~20 to about~~ 300.

[c41] 41. An icemaker assembly according to claim 28 wherein a nominal number of rows (r) of said ice cube molds is in the range between about 10 to about 30.

[c42] 42. An icemaker assembly according to claim 28 wherein a nominal number of columns (c) of said ice cube molds in the range between about 2 to about 10.

[c43] 43. An icemaker assembly according to claim 28 wherein the dimensions of an individual ice cube mold include a nominal length (x) in the range between about 0.75 inches to about 2 inches and a nominal width (y) is in the range between about 0.5 inches to about 1.5 inches.

[c44] 44. An icemaker assembly according to claim 28 wherein said ice cube molds comprise a variety of ornamental cube shapes.

[c45] 45. An icemaker assembly according to claim 44 wherein said ornamental cube shapes include fish, penguins, scallops, and hemispheres.

[c46] 46. An icemaker assembly according to claim 28 wherein said first ice cube storage bin is molded directly into said freezer door assembly.

[c47] 47. An icemaker assembly according to claim 28 wherein said first ice cube storage bin is fixedly attached to said freezer door assembly.

[c48] 48. An icemaker assembly according to claim 28 wherein said first ice cube storage bin is removeably disposed within a portion of said freezer door assembly.

[c49] 49. An icemaker assembly according to claim 28 further comprising a harvester bar positioned adjacent to said front roller so as to contact a portion of each respective ice cube as said ice cube molds rotate forward over said front roller to assist ice cubes to eject from said ice cube molds.

[c50] 50. An icemaker assembly according to claim 29 wherein said refill valve is positioned within said freezer compartment generally positioned above at least one row of said ice cube molds.

[c51] 51. An icemaker assembly according to claim 29 wherein said refill valve is actuated when a belt position sensor generates a signal to said controller indicating that said conveyor belt is in the correct position for refill.

[c52] 52. An icemaker assembly according to claim 51 wherein said belt position sensor detects holes that are punched though a band that extends from a bottom web of said conveyor belt past a sidewall of a respective ice cube mold.

[c53] 53. An icemaker assembly according to claim 52 wherein an IR light emitting diode positioned adjacent said band emits light that reaches a photodiode positioned below said band only when a hole passes therebetween.

[c54] 54. An icemaker assembly according to claim 53 wherein said controller determines whether said hole is present by processing a signal from said photodiode and if said hole is between said light emitting diode and said photodiode said controller stops said first motor and commences a water dose.

[c55] 55. An icemaker assembly according to claim 29 wherein said refill valve is a doser mechanism consisting of a rotary multiport valve and a doser housing.

[c56] 56. An icemaker assembly according to claim 55 wherein said doser housing consists of an enclosed volume of about 10-50 ml divided into a first section and a second section by a flexible diaphragm.

[c57] 57. An icemaker assembly according to claim 56 wherein tubing connects said rotary valve and an icemaker fill tube, a water dispenser tube and a water supply.

[c58] 58. An icemaker assembly according to claim 57 wherein said valve simultaneously connects said water supply to said first section of said doser housing and said ice maker fill tube to said second section of said doser housing during a refill and the pressure of said water supply pushes said flexible diaphragm displacing the water in said second section of said doser housing to said fill tube and after an appropriate amount of time for said diaphragm to fully transverse said second section said rotary valve is moved to connect said water supply to said second section of said doser housing and simultaneously connect said first section of said doser housing with said icemaker fill tube wherein said water supply pressure forces said diaphragm back across said doser housing displacing the water in said first section

of said doser housing to said fill tube.

[c59] 59. An icemaker assembly according to claim 28 wherein said second ice cube storage bin is disposed in a lower portion of said freezer door below said first ice cube storage bin.

[c60] 60. An icemaker assembly according to claim 28 further comprising a detection sensor is coupled to said second ice cube storage bin to prevent said ice maker assembly from sending ice cubes to said second ice cube storage bin when second ice cube storage bin is not in place.

[c61] 61. An icemaker assembly according to claim 60 wherein said detection sensor is a microswitch that is actuated by a special geometrical feature of said second ice cube storage bin.

[c62] 62. An icemaker assembly according to claim 61 wherein said special geometrical feature of said second ice cube storage is a pin or a tab.

[c63] 63. An icemaker assembly according to claim 60 wherein said detection sensor is an inductive proximity sensor that detects a metal insert on said second ice cube storage bin.

[c64] 64. An icemaker assembly according to claim 60 wherein said detection sensor is an optical sensor that detects a reflecting surface adhered to said second ice cube storage bin.

[c65] 65. An icemaker assembly according to claim 28 further comprising, a first fullness sensor disposed within or about said first ice cube storage bin that generates a signal to said controller that the level of ice cubes within second ice cube storage bin has dropped below a preset fill level initiating a cycle and said controller energizes said first motor.

[c66] 66. An icemaker assembly according to claim 65 wherein said first motor is energized when the fullness of ice cubes in said first ice cube storage bin falls below a preset fill level and an ice-ready sensor generates a signal to said controller that a respective row of ice cubes to be delivered is frozen and a cycle is initiated and said first motor advances said conveyor belt one full row of said ice cube molds and said refill valve delivers water to a row of said empty molds.

[c67] 67. An icemaker assembly according to claim 66 wherein said ice-ready sensor is a temperature sensor in sliding contact with said belt and is positioned adjacent said front roller where ice cubes are delivered.

[c68] 68. An icemaker assembly according to claim 67 wherein said temperature sensor is a thermistor or a thermocouple.

[c69] 69. An icemaker assembly according to claim 66 wherein time and temperature are integrated to provide a degree-minute set point beyond which it is known that the ice is frozen.

[c70] 70. An icemaker assembly according to claim 66 wherein a temperature cutoff is used below which it is known that the ice is frozen.

[c71] 71. An icemaker assembly according to claim 70 wherein said temperature cutoff is about15oF.

[c72] 72. An icemaker assembly according to claim 66 wherein said ice-ready sensor is a capacitance sensor positioned below said belt near said front roller so as to form part of a capacitance bridge circuit.

[c73] 73. An icemaker assembly according to claim 72 wherein an excitation frequency is applied to said capacitance bridge and said bridge is balanced such that when a respective ice cube mold is empty the voltage across said bridge is nearly zero and when water is in a respective ice cube mold the capacitance reading of said ice-ready sensor increases dramatically, because the dielectric constant of water is about 80 times that of air, causing the bridge to become unbalanced. and as water freezes, the dielectric constant decreases to about 6 times that of air, reducing the imbalance of the bridge and decreasing the signal sent by said ice-ready sensor to said controller.

[c74] 74. An icemaker assembly according to claim 65 wherein said fullness sensor is a weight determining means.

[c75] 75. An icemaker assembly according to claim 74 wherein said weight determining means is a microswitch.

[c76] 76. An icemaker assembly according to claim 65 wherein said fullness sensor is an ultrasonic level detector.

[c77] 77. An icemaker assembly according to claim 76 wherein said ultrasonic level detector comprises an ultrasonic transmitter, an ultrasonic receiver and an electronic circuit capable of causing said transmitter to emit a short burst of ultrasound and capable of measuring the time interval between said short burst and a return echo received by receiver wherein this time interval is proportional to the distance between said fullness sensor and a top layer of ice cubes.

[c78] 78. An icemaker assembly according to claim 65 wherein said fullness sensor comprises an optical proximity switch that detects the fullness of said second ice cube storage bin when said optical switch sends out light and detects a reflected light intensity with a photodiode such that high intensity of reflected light indicates close proximity of ice or fullness.

[c79] 79. An icemaker assembly according to claim 48 further comprising a second fullness sensor disposed within or about said second ice cube storage bin that generates a signal to said controller that the level of ice cubes within second ice cube storage bin has dropped below a preset fill level initiating a cycle and said controller energizes said second motor to rotate auger mechanism disposed within said first ice cube storage bin.

[c80] 80. An icemaker assembly according to claim 79 wherein said controller generates a signal to switch a diverter to block ice chute from delivering ice cubes to a dispenser and to allow passage of ice cubes to said second ice cube storage bin.

[c81] 81. An icemaker assembly according to claim 79 wherein said fullness sensor is a weight determining means.

[c82] 82. An icemaker assembly according to claim 81 wherein said weight determining means is a microswitch.

[c83] 83. An icemaker assembly according to claim 79 wherein said fullness sensor is an ultrasonic level detector.

[c84] 84. An icemaker assembly according to claim 83 wherein said ultrasonic level detector comprises an ultrasonic transmitter, an ultrasonic receiver and an electronic circuit capable of causing said transmitter to emit a short burst of ultrasound and capable of measuring the time interval between said short burst and

a return echo received by receiver wherein this time interval is proportional to the distance between said fullness sensor and a top layer of ice cubes.

[c85] 85. An icemaker assembly according to claim 83 wherein said fullness sensor comprises an optical proximity switch that detects the fullness of said second ice cube storage bin when said optical switch sends out light and detects a reflected light intensity with a photodiode such that high intensity of reflected light indicates close proximity of ice or fullness.

[c86] 86. An icemaker assembly comprising: a conveyor assembly; a first motor drivingly coupled to said conveyor assembly; a second motor drivingly coupled to an ice crusher and an auger mechanism; a refill valve positioned adjacent to conveyor assembly; a first ice cube storage bin, a removable second ice cube storage bin, and a controller electrically coupled to said first motor and said second motor.

[c87] 87. An icemaker assembly according to claim 86 wherein said conveyor assembly comprises at least a front roller and a rear roller and a continuous flexible conveyor belt fitted in tension about said front and rear rollers, said conveyor belt having a multiplicity of individual ice cube molds for creation of individual cubes therein.

[c88] 88. An icemaker assembly according to claim 86, further comprising a belt position sensor that generates a signal to said controller indicating that said conveyor belt is in a correct refill position.

[c89] 89. An icemaker assembly according to claim 86, further comprising a first fullness sensor disposed within or about first ice cube storage bin that generates a signal to controller when the level of ice cubes within first ice cube storage bin falls below a preset level.

[c90] 90. An icemaker assembly according to claim 86, further comprising a second fullness sensor disposed within or about second ice cube storage bin that generates a signal to controller when the level of ice cubes within second ice cube storage bin falls below a preset level.

[c91] 91. An icemaker assembly according to claim 86, further comprising an ice ready sensor that generates a signal to controller that a respective row of ice cubes is frozen.

[c92] 92. An icemaker assembly comprising: a means for conveying ice; a first motor means drivingly coupled to said means for conveying; a second motor means drivingly coupled to an ice crushing means and an auger means; a means for refilling is positioned adjacent to said means for conveying; a first means for storing ice, a removable second means for storing ice, and a means for controlling coupled to said first motor means and said second motor means.

Figures